Simulating turbulent flows in complex geometries

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Large-eddy simulation (LES) has traditionally been restricted to fairly simple geometries. Most computations in engineering geometries have been in the context of the Reynolds-averaged Navier-Stokes equations. We will discuss our work on developing the capability to reliably perform LES in engineering configurations. We will present a computational approach to direct numerical simulation and LES of incompressible turbulent flows on unstructured grids. Special attention has been paid to ensuring robustness at high Reynolds numbers on skewed grids without numerical dissipation. Results will be presented for a range of flows such as isotropic turbulence, flow over a cylinder, jets in cross-flow and the flow in a Pratt & Whitney gas-turbine combustor. Most of the discussion will pertain to incompressible flows; however, ongoing work on compressible turbulent flows will also be presented.